Job Hazard Analysis for NOvA Beryllium Fin Comparison

Job Name: NOvA Beryllium Target 13
Estimated Start Date: 6 Dec 2013 **Estimated Job Duration:** 2 Days
Work to be performed by: AD personnel
Location: MI-8 (east)
Responsible Engineers: Mike McGee **Phone:** 3904
Task Manager: Chris Kelly **Phone:** 6801

Description of work:

This step-by-step procedure describes in detail the preparation and thermal testing of Beryllium Target Fins.

Pre-Test Preparation

- Collect test equipment; (1) Dell Laptop with Labview loaded, (1) NI Chassis with (2) 4-channel TC modules and (1) conventional module, (4) Type-J thermocouples, (4) light-link type Thermal Sensors, Light-Link Thermal Sensor Controller
- Prepare (3) graphite end fins (MC-433742), (3) graphite mid-fins (MC-433728), (1) beryllium end fin (MC-433960) and (1) beryllium mid-fin (MC-433959)
- Provide (1) target cooling rail, (2) target pressing plates and associated hardware
- Any water connections needed
- Fabricate; (2) 0.005" thick x 0.75" x 3.875" strips of graphite (C) foil as shown in Figure 1(b)

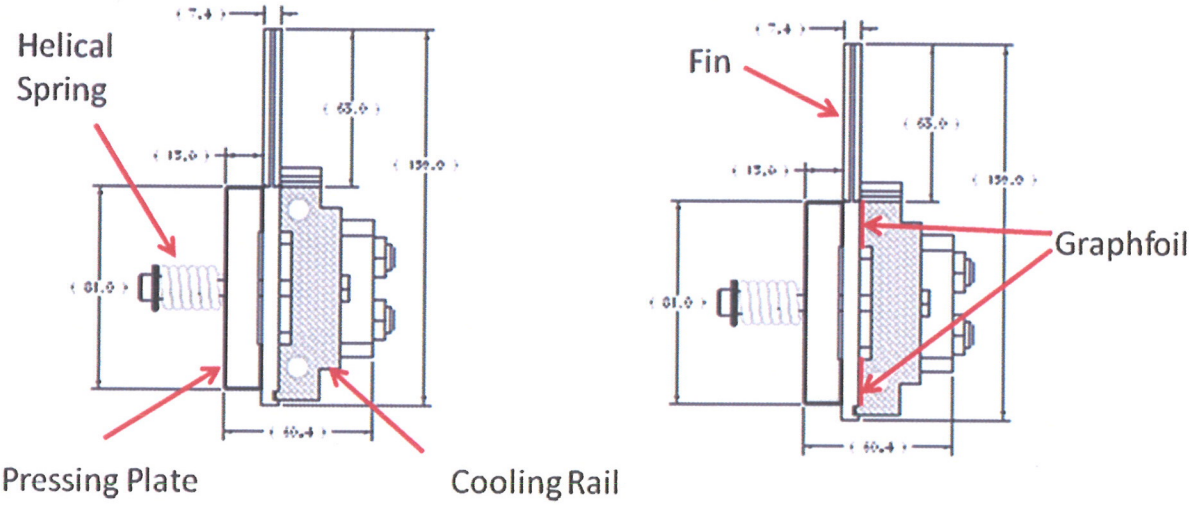

Figure 1(a). Section view of target cooling rail. 1(b). Location of graphfoil.

Setup for Test

- Note: during assembly of cooling rail test setup, always use Nitrile gloves
- Connect thermocouple wires to NI-chassis and boot laptop
- Start DAQ Labview (vi) script for test
- Apply an even pressure of 0.3 MPa [43.5 psi] as specified in the IHEP original design over the pressing plate area (2 x 97.5 mm x 18 mm) which is in contact with the (4) fins
- Note that each of the (2) Lee helical springs carries an 840 lb/in rate
- Therefore, each M6 x 1 x 80 mm (7075-T73) SHCS should be linearly displaced 0.141" (or 3.6 turns) past being snug against the spring, evenly
- Assembly should be mounted on table so that the fins are vertical

Data Measurement

- Start DAQ process within Labview vi file (script) and confirm data is being taken
- Setup digital thermal imaging camera, focused on the fin sections
- Start pump, thereby water flow through the horn cooling water test setup with target cooling rail isolated (see Figures 2(a) and 2(b) as reference)
- Ramp up heater using variac so that circulating water temperature reaches 50 degrees C under stable conditions
    - Allow water circulation for 10 minutes to ensure stable temperature at 50 degrees C
    - Start video or still (frame) process of digital thermal imaging camera
    - Open outlet valve feeding from target cooling rail, open inlet valve, and quickly close the isolation valve between them sending water flow towards the target cooling rail
- Allow fins to reach thermal equilibrium
- Terminate test and isolate water flow to target cooling rail, however continue to heat the water at 50 degrees C

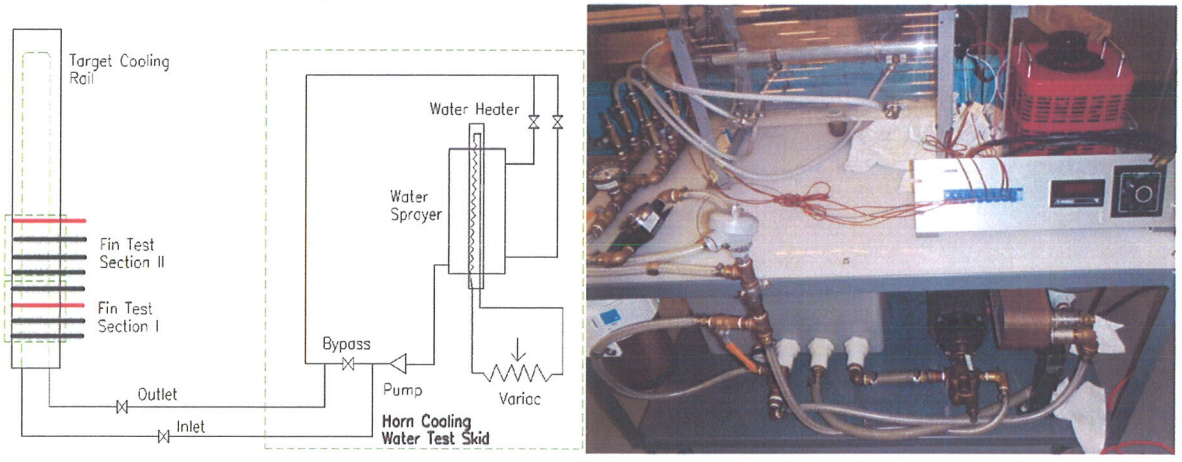

Figure 2(a). Water circuit. 2(b). Horn cooling water (spray) setup used as a water/heating source.

Breakdown existing test assembly by removing pre-load on springs evenly and therefore, from pressing plate sections 1 and 2. Carefully, remove graphite and beryllium fins from these sections and apply the graphfoil to the areas indicated in Figure 1(b). Re-assemble fins in original positions and attach pressing plates to sections 1 and 2. Evenly tighten the M6 screws to achieve a linear displacement of 0.141" (or 3.6 turns) past snug against the spring. Enter sub-page in Labview script and rename DAQ folder name (within path description).

- Start DAQ process within Labview vi file (script) and confirm data is being taken
- Ensure that circulating water temperature has remained at 50 degrees C and is stable
    - Allow water circulation for 10 minutes to ensure stable temperature at 50 degrees C
    - Start video or still (frame) process of digital thermal imaging camera
    - Open outlet valve feeding from target cooling rail, open inlet valve, and quickly close the isolation valve between them sending water flow towards the target cooling rail
- Allow fins to reach thermal equilibrium
- Terminate test

Associated Hazards

- Sharp edges on fixture and other equipment
- Burns from heaters and test fixture while heating
- Electric shock from use of AC circuit
- Beryllium (Be) material is harmful through inhalation and if swallowed. Also, harmful in contact with skin or eyes

Hazard Mitigation

- The entire operation is pre-planned (as stated above)
- All personnel involved will be briefed regarding their functions and responsibilities
- Only experienced and trained personnel will be conducting the material testing
- Inspect water heaters and electrical connections prior to use
- All personnel involved in the operation will have the following Personal Protection Equipment (PPE): safety shoes, safety glasses, respirator, thermal and nitrile gloves
- All AC electrical connections are properly isolated and covered
- Test fixture is properly grounded with respect to AC power source
- Presence of a combined Class A, B and C fire extinguisher (for electrical equipment, where the extinguishing agent is non-conductive)

- Keep non-essential personnel clear of work area
- Read MSDS for Beryllium material (see attached documents)
- All personnel shall be beryllium trained (or qualified)

Prepared by: _____ Date: 9 Dec 2013
(Mike McGee, Responsible Engineer)

Approved by: David Cathey Date: Dec 9, 2013
(Dave Cathey, AD Safety Officer)

Approved by: _____ Date: 12 | 9 | 2013
(Richard Rebstock, AD Safety Officer)

My supervisor has reviewed this hazard analysis with me and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so.

Name (print)	Signature	Date